

Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

- | | |
|-------------------------------------|---|
| n/a | Confirmed |
| ☒ | ☐ The exact sample size (<i>n</i>) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☐ | ☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☒ | ☐ The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☒ | ☐ A description of all covariates tested |
| ☒ | ☐ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☒ | ☐ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☒ | ☐ For null hypothesis testing, the test statistic (e.g. <i>F</i> , <i>t</i> , <i>r</i>) with confidence intervals, effect sizes, degrees of freedom and <i>P</i> value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☐ | ☒ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☐ | ☒ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☒ | ☐ Estimates of effect sizes (e.g. Cohen's <i>d</i> , Pearson's <i>r</i>), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection VG Studio Max 3.4

Data analysis MrBayes 3.2.4; PAUP* (Version 4.0a152); FigTree v1.4.4

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

Data availability. In addition to the material presented in the main text and the specimens deposited at the museums (see above), supporting images, graphics and essential phylogenetic data are provided in the Extended Data and Supplementary Information. CT and CL scanning data are available on the Archives of Digital Morphology, Key Laboratory of Vertebrate Evolutionary Systems Science of the Chinese Academy of Sciences (<http://www.admorph.org>), the dois are 10.12112/M.101 for Fossiomanus sinensis and 10.12112/M.102 for Jueconodon cheni. Life Science Identifiers (LSID) for the new genus and species have been registered at Zoobank as: Fossiomanus Mao, Zhang, Liu & Meng, In Press LSIDurn:lsid:zoobank.org:act:C579314D-6330-4D7F-9C71-AF7E8DC9A1DD; Fossiomanus sinensis Mao, Zhang, Liu & Meng, In Press LSIDurn:lsid:zoobank.org:act:3D66E77B-F3A1-4A0D-923B-11121CB934EC; Jueconodon Mao, Zhang, Liu & Meng, In Press LSIDurn:lsid:zoobank.org:act:580A4D81-BFFE-4BE7-BDE9-267ED929CA3A; Jueconodon cheni Mao, Zhang, Liu & Meng, In Press

LSIDurn:lsid:zoobank.org:act:C97D7EF4-68C4-4B09-9E78-BA6F48ADCA09. The data matrix is deposited in MorphoBank (<http://www.morphobank.org>). The data matrix for the phylogenetic analysis is in the Supplementary Information as well as deposited in MorphoBank (project number 3943).

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	Our study reports two new species of Cretaceous mammalian morphs. We described the morphologies and diagnosed the new species in comparison with fossil and extant taxa. We present a phylogenetic analysis with focus on mammalian morphs and discussed the convergent evolution of fossoriality and evolutionary development.
Research sample	Each new species is based on a single specimen. The phylogenetic analysis is based on 121 generic level taxa and 551 morphological characters.
Sampling strategy	Within the species selected for the study, we have sampled fossils and extant specimens as broadly as possible but were limited by the availability to some specimens for which we used casts, CT scan, and photographs. The data are specifically selected to address the phylogenetic relationship of mammalian morphs.
Data collection	Data were collected by direct examination of fossils available to us, museum specimens of extant taxa, as well as from literatures relevant to the subject in our study. Data collection were done by F.M and J.M.
Timing and spatial scale	Our work started at least three years ago. The most time consuming task is to prepare the specimens in several stages and to obtain the computed laminography and CT data in multiple scans. The fossils under study were Early Cretaceous was in age and our comparative sample included primarily Mesozoic fossils along with extant mammal species.
Data exclusions	The data set was built up to address the phylogenetic relationship of mammalian morphs and the comparative specimens are chosen for their relevance to the study. No data were excluded.
Reproducibility	Parsimony and Bayesian analyses were conducted in two labs independently and the results are consistent. The data in our work are explicitly documented to allow replication and the data set will be included in the Supplementary Information section as well as deposited at MorphoBank.
Randomization	The description of each species is based on a single specimen; randomization is not applicable to our study.
Blinding	Our study was based on direct observation of specimens and on published literatures; blinding was not required.
Did the study involve field work?	☐ Yes ☒ No

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☐	☒ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Palaeontology and Archaeology

Specimen provenance	The two specimens were collected, respectively, from the Jiufotang Formation at Lamadong, Jianchang, Liaoning and from the Yixian Formation at Jianshangou, Beipiao, Liaoning. The provenances of the specimens were ascertained by the collectors on site, by the
---------------------	--

lithological match of the slabs to the strata of the sites, and by co-existence of index fossils on the same slabs, respectively (see Supplementary Information). Permissions to study these specimens were given by the two museums (see below) that own the specimens and where the specimens are deposited.

Specimen deposition

The holotype specimen of *Fossiomanus sinensis* (JZMP-2107500093) has been deposited at the Jinzhou Paleontological Museum, Liaoning Province, China. The holotype specimen of *Jueconodon cheni* (ZGY0052) has been deposited at the Beipiao Pterosaur Museum of China, Beipiao County, Liaoning Province, China).

Dating methods

Radiometric dating data of the strata yielding the specimens are extensive, which we have introduced in length in the Supplementary Information. In addition, as we discussed in the Supplementary Information in more details, the tritylodontid specimen is preserved together with the fish *Jinanichthys* on the same slab; the latter is an index fossil for the Jiufotang Formation. The eutriconodontan specimen is preserved in the slab that also contains numerous carapaces of *Eosestheria*, which is an index invertebrate fossil for the Yixian Formation. These associated index fossils provide another set of biostratigraphic data for age determination.

☒ Tick this box to confirm that the raw and calibrated dates are available in the paper or in Supplementary Information.

Ethics oversight

Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing; American Museum of Natural History, New York, New York, USA.

Note that full information on the approval of the study protocol must also be provided in the manuscript.